



Application No.: 10/661,221

Reply to Office Action issued 04/03/2007

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Amendments to the Claims:

Please amend the currently outstanding claims as follows:

1. (Currently Amended) A method of removing contaminants from water comprising the steps of:

(a) providing a water feed directly downstream of and in-line with process water exposed to hydrocarbon and/or chemical processing by hydrocarbon or chemical processing equipment, wherein said water feed contains a large proportion of contaminants to water, the contaminants including one or more of nitrogen-containing compounds, carbonate, hydrogen sulfide, selenium, other sulfur acids and organic acids resultant from said processing equipment;

(b) providing a reverse osmosis system in-line with said water feed, ~~with there being no pre-filtering step in said water feed between said hydro-carbon or chemical processing equipment and~~ said reverse osmosis system capable of withstanding desired process parameters in water feed temperatures up to 185° F and being directly connected to said water feed,[[;]] said reverse osmosis system comprising an inlet, at least one reverse osmosis membrane, a permeate outlet, and a reject outlet;

(c) applying pressure or adjusting pressure of said water feed to a degree sufficient to force said water feed through said reverse osmosis system and to effect a reverse osmosis process comprising separating said water feed into permeate and reject which includes at least one of said contaminants;

(d) directing said permeate to said permeate outlet; and

(e) directing said reject to said reject outlet.

2. (Canceled).

3. (Previously Presented) The method of claim 1, wherein said nitrogen-containing

compounds are selected from the group consisting of ammonia and amines.

4. (Original) The method of claim 1, wherein said reverse osmosis membrane comprises a spiral wound thin-film composite membrane.
5. (Original) The method of claim 1, wherein said reject comprises a contaminant selected from the group consisting of ammonia and amines.
6. (Original) The method of claim 1, further comprising the step of adjusting the pH of said water feed.
7. (Original) The method of claim 6, wherein said adjusting includes (i) the addition of a strong acid, wherein the desired contaminant to be removed is a basic species, or (ii) the addition of a strong base wherein the desired contaminant to be removed is an acidic species.
8. (Original) The method of claim 1, further comprising the step of providing a deaerator in-line with said water feed upstream of said reverse osmosis system.
9. (Original) The method of claim 8, further comprising the step of adjusting the pH of said water feed upstream of said deaerator.
10. (Original) The method of claim 1, further comprising the step of providing at least one pre-treatment system in-line with said water feed upstream of said reverse osmosis system.
11. (Original) The method of claim 10, wherein said pre-treatment system comprises

filtration selected from the group consisting of nanofiltration, ultrafiltration, microfiltration, and activated carbon filtration.

12. (Original) The method of claim 1, wherein said pressure is applied in a range from about 5 psig to about 300 psig.

13. (Currently Amended) The method of claim 1, wherein said method is conducted in a temperature range from about ~~[[60]]~~125°F to about 185°F, typical temperature of a sour water stripper water feed.

14. (Original) The method of claim 3, wherein said permeate comprises a concentration of contaminants from about 80% to about 100% less than said water feed.

15. (Original) The method of claim 1, further comprising the step of recycling said permeate into said hydrocarbon process.

16. (Original) The method of claim 1, further comprising the steps of:

(f) providing a second reverse osmosis system downstream of said permeate outlet of said reverse osmosis system of step (b), said second reverse osmosis system comprising an inlet, at least one reverse osmosis membrane, a permeate outlet, and a reject outlet;

(g) adjusting the pH of said permeate prior to introduction to said permeate to said second reverse osmosis system;

(h) applying pressure or adjusting pressure of said permeate of the reverse osmosis system of step (b) at said inlet of said second reverse osmosis system a degree sufficient to force said permeate of the reverse osmosis system of step (b) through said second reverse osmosis system to effect a second reverse osmosis process separating said permeate of the reverse

osmosis system of step (b) into a second permeate and second reject which includes at least one of said contaminants.

17. (Original) The method of claim 16, wherein said second reject comprises a contaminant comprising organic acids and sulfur acids.

18. (Original) The method of claim 17, further comprising the step of adjusting the pH of at least one of said second permeate or said second reject.

19. (Currently Amended) An apparatus for the removal of contaminants from process condensate comprising:

(a) a water feed conduit; ~~said conduit connected to~~ supplying a water feed directly downstream of and in-line with process water exposed to hydrocarbon and/or chemical processing by hydrocarbon or chemical refining equipment, wherein the contaminants include a large proportion of hydro-carbon in the process condensate resultant from said processing equipment; and

(b) a reverse osmosis system comprising an inlet, at least one reverse osmosis membrane, a permeate outlet, and a reject outlet, wherein ~~there not being a step of pre-filtering between the chemical and/or processing step and the step of forcing the water feed through~~ said reverse osmosis system is capable of separating molecular species in water feed temperatures up to 185° F and is directly connected to said water feed.

20. (Original) The apparatus of claim 19, further comprising:

(c) at least one of the following:

(i) a pump upstream of said reverse osmosis system capable of applying

pressure to said water feed to force said water feed through said reverse osmosis system; and

(ii) a pressure control device to reduce the pressure of said water feed to an appropriate level to effect a reverse osmosis process.

21. (Previously Presented) The apparatus of claim 19, further comprising:

(c) a second reverse osmosis system comprising an inlet, at least one reverse osmosis membrane, a permeate outlet, a reject outlet;

said second reverse osmosis system being downstream of said permeate outlet of said reverse osmosis system of step (b) wherein said permeate outlet comprises a second conduit which leads to said inlet of said second reverse osmosis system;

(d) said second conduit including an inlet for injection of a strong base or strong acid;

(e) a second pump upstream of said second reverse osmosis system capable of applying pressure to said permeate of said reverse osmosis system of step (b) to force said permeate through said second reverse osmosis system.

22. (Previously Presented) The apparatus of claim 19, wherein said water feed conduit further comprises at least one pre-treatment system and a pH adjustment system configured to force nitrogen containing contaminants to flow out as a reject instead of as a permeate.

23. (Original) The apparatus of claim 22, wherein said pretreatment system comprises a filter comprising a member selected from the group consisting of a nanofiltration membrane, an ultrafiltration membrane, a microfiltration membrane and activated carbon filter.

24. (Currently Amended) A method for the removal of contaminants from water comprising the steps of:

(a) providing a water feed directly downstream of and in-line with process water exposed to hydrocarbon and/or chemical processing by hydrocarbon or chemical processing equipment, wherein said water feed contains a large proportion of contaminants to water, the contaminants including one or more of nitrogen-containing compounds, carbonate, hydrogen sulfide, selenium, other sulfur acids and organic acids resultant from said processing equipment;

(b) providing a first reverse osmosis system in-line with said water feed, ~~with there being no pre-filtering step in said water feed between said hydro-carbon or chemical processing equipment and said first reverse osmosis system~~ capable of withstanding desired process parameters of water temperatures up to 185° F and being directly connected to said water feed,
[[;]] said reverse osmosis system comprising a first inlet, at least one reverse osmosis membrane, a first permeate outlet, and a first reject outlet;

(c) applying pressure or adjusting pressure of said water feed to a degree sufficient to force said water feed through said first reverse osmosis system and to effect a reverse osmosis process comprising separating said water feed into a first permeate and a first reject which includes at least one of said contaminants;

(d) directing said first permeate to said first permeate outlet;

(e) directing said first reject to said first reject outlet;

(f) providing a second reverse osmosis system downstream of said first permeate outlet, said second reverse osmosis system comprising a second inlet, at least one reverse osmosis membrane, a second permeate outlet, and a second reject outlet[[;]], wherein said first permeate outlet feeds into said second inlet;

(g) adjusting the pH of said first permeate prior to introduction of said first permeate to said second reverse osmosis system; and

(h) applying pressure or adjusting pressure of said first permeate at said inlet of said second reverse osmosis system a degree sufficient to force said first permeate through said second reverse osmosis system to effect a second reverse osmosis process separating said first

permeate into a second permeate and second reject which includes at least one of said contaminants.

25. (Original) The method of claim 24, wherein said adjusting the pH of step (g) comprises providing a break tank for said first permeate to control pressure and pH addition prior to introduction to said second reverse osmosis system.

26. (Original) The method of claim 24, further comprising the step of providing a break tank upstream of said first reverse osmosis system to adjust the pH of said water feed and to release dissolved gas from within said water feed.

27. (Original) The method of claim 24, wherein said first reject comprises at least one of ammonia and amines and said second reject includes organic acids and sulfur acids.

28. (Original) The method of claim 24, further comprising the step of providing at least one pre-treatment system upstream of said first osmosis system.

29. (Currently Amended) A method of removing contaminants from water through a multi-stage reverse osmosis process comprising the following steps:

(a) completing the following steps of stage one:

(i) providing a water feed directly downstream of and in-line with process water exposed to hydrocarbon and/or chemical processing by hydrocarbon or chemical processing equipment, wherein said water feed contains a large proportion of contaminants to water, the contaminants including one or more of nitrogen-containing compounds, carbonate, hydrogen sulfide, selenium, other sulfur acids and organic acids resultant from said processing equipment;

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- (ii) providing a stage one reverse osmosis system capable of separating molecular species in water temperatures up to 185° F and being directly in-line with said water feed[[;]], said stage one reverse osmosis system comprising a stage one inlet, at least one reverse osmosis membrane, a stage one permeate outlet, and a stage one reject outlet;
 - (iii) applying pressure or adjusting pressure of said water feed to a degree sufficient to force said water feed through said stage one reverse osmosis system and to effect a reverse osmosis process comprising separating said water feed into a stage one permeate and a stage one reject which includes at least one of said contaminants;
 - (iv) directing said stage one permeate to said stage one permeate outlet; and
 - (v) directing said stage one reject to said reject one outlet; and
- (b) completing at least one additional reverse osmosis process wherein a reject from a previous step is introduced to a reverse osmosis system of an immediately following subsequent step; said additional reverse osmosis process comprising the following steps:
- (i) providing a stage two reverse osmosis system downstream of said stage one reject outlet, said stage two reverse osmosis system comprising a stage two inlet, at least one reverse osmosis membrane, a stage two permeate outlet, and a stage two reject outlet; wherein said stage one reject outlet feeds into said stage two inlet;
 - (ii) applying pressure or adjusting pressure of said stage one reject at said inlet of said stage two reverse osmosis system to a degree sufficient to force said stage one reject through said stage two reverse osmosis system to effect a second reverse osmosis process separating said stage one reject into a stage two permeate and a stage two reject which includes at least one of said contaminants; and
- (c) combining said stage one permeate and said stage two permeate, ~~wherein there not being a step of pre-filtering between the chemical and/or processing step and the step of forcing the water feed through said reverse osmosis system.~~

30. (Previously Presented) The method of claim 6, wherein said step of adjusting the pH of said water feed involves setting pH level below 6.5 to remove said nitrogen-containing compounds and group consisting of ammonia and amines.
31. (Previously Presented) The method of claim 6, wherein said step of adjusting the pH of said water feed involves elevating pH level to increase removal of said acid.
32. (Previously Presented) The method of claim 1, wherein said hydrocarbon or chemical processing equipment produces said water feed as a process condensate.
33. (Previously Presented) The method of claim 1, wherein said hydrocarbon or chemical processing equipment utilizes caustic feed mechanism resulting in said water feed.
34. (Previously Presented) The method of claim 1, wherein said step of applying pressure or adjusting pressure of said water feed forces nitrogen containing contaminants to flow into said reject instead of said permeate.